Fields of applications:
Due to its flexibility, modularity, and customizability, Martec's SMCS can easily meet all the requirements of ships of any size and type, from large cruise vessels to yachts, mega yachts, ferries and naval vessels (aircraft carriers, cruisers, frigates, corvettes, destroyers). Special attention has been placed to ergonomic design and usability of the system, as they are crucial factors to reach high level of performances. For this reasons, Martec SMCS system is well suited to monitor not only large vessels, but also complex environments like off-shore (i.e. oil rigs, FPSO, fixed platforms, etc.) and large industrial or public buildings.

Certifications:
LR Software Conformity Assesment.

Main Final Customers:
Princess Cruises, Cunard, Costa Crociere, Carnival Cruise Line, Carnival Australia, Carnival UK, AIDA, Holland American Line, Silversea, Seabourn Cruise Line, Compagnie du Ponent, Hapag Lloyd.

Main Yards:
Fincantieri, Meyer Werft, Mitsubishi H.I., STX France, Lloyd Werft, Mariotti

System benefits:
- ✓ Open architecture enabling full integration with the safety systems onboard.
- ✓ Distributed system configuration.
- ✓ Effective support to the operators during emergency situations.
- ✓ Robust software tested and approved in accordance to LRS Software Conformity Assessment.
- ✓ High availability thanks to redundancy at all system levels.
- ✓ Advanced Man-Machine Interface.
- ✓ Proven solutions based on a large application experience.
- ✓ Prepared for future expansion.

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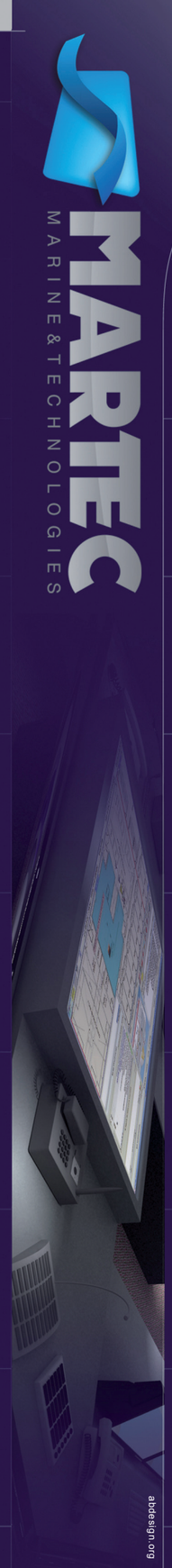

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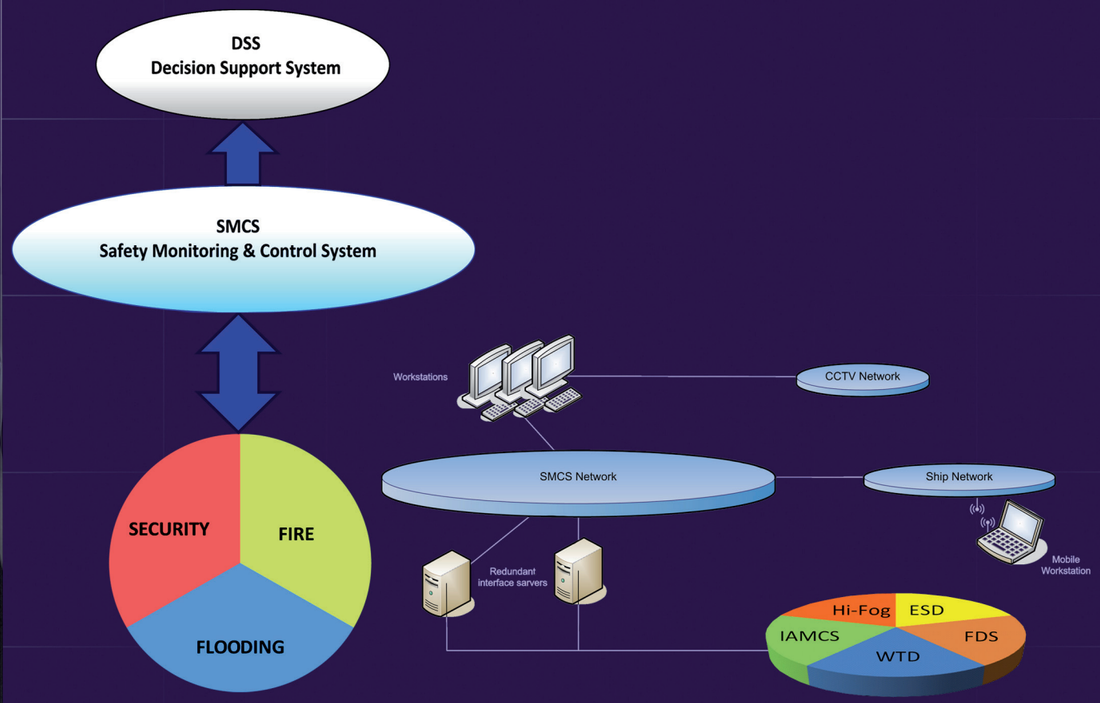
Safety Monitoring and Control System

Product description:
The Safety Monitoring & Control System (SMCS) is a supervisory system, interfacing all the Safety Systems onboard the vessel and coordinating the activities among them.

The SMCS will:
- interface the ship Safety Systems, collecting data from them and/or sending commands to them;
- display to the SMCS operators the status of all the elements monitored, by means of a graphic Man Machine Interface (MMI) with vector-based mimics;
- detect the alarms generated by Safety Sub-Systems and automatically reporting them to the SMCS operators;
- trigger safety actions according to a global safety strategy stored inside its database. Such global strategy will co-ordinate the actions of several Sub-Systems;
- activate preplanned actions in automatic sequence or requiring operator acknowledgement;
- suggest best procedure to fight emergency, thanks to Decision Support System (DSS) extension.

The SMCS is based on a distributed architecture, whose Block Diagram is shown in the following picture:

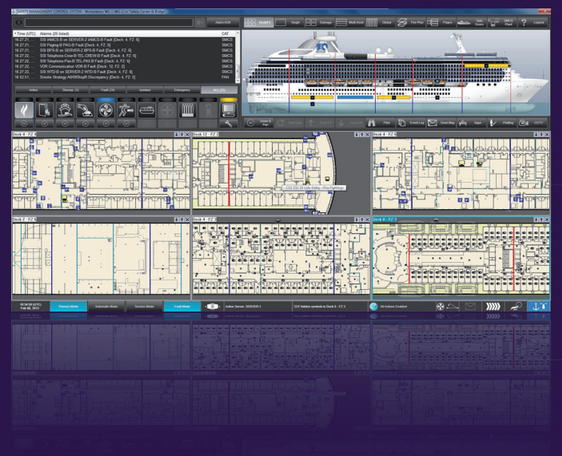


The SMCS architecture includes three basic elements:

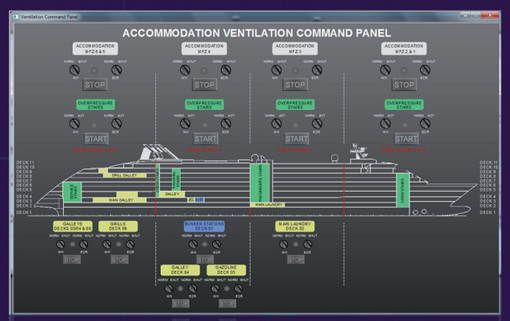
- LAN
  Purpose of the LAN is to connect all the SMCS computers among them and according to high reliability and availability criteria. It is an Ethernet industrial network, using a redundant fiber optic ring which guarantees continuous operation even in case of (single) failure.
- Operator Workstations
  They are used by the Operators to monitor and control the whole ship safety stations. The Workstations can be fixed PCs, tablet PCs, panel PCs. Touch screen control system is also available.
- SMCS Server PC
  These PCs act as gateways between the SMCS and other Safety Systems, and as servers for SMCS operator workstations. The communication with external Systems takes place via different protocols. Just as examples: Fire detection system, Hi-Fog System, HVAC System, Automation system, Security System, CCTV, VDR, WTD, Telephone, Paging, ESD.

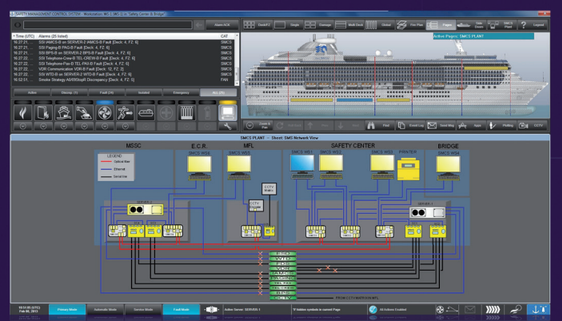
All workstations of the SMCS have the same Man Machine Interface, allowing SMCS operators to display:

- SMCS operational status information.
- Alarm list.
- Ship profile (used to show where alarms and fault are located on the ship).
- Decks in different views:
  - **Deck/FZ View** : shows up to six Fire Zone at the same time.
  - **Single View**: shows a single Deck.
  - **Multi-Deck View**: shows up to 3 windows, each window showing an entire Deck.
  - **Side View**: shows two profile views of the ship.
  - **Global View**: shows up to 16 Decks of the same Fire Zone.
  - **Additional Special View**: according to specific Owner or Yard requirements, it is possible to insert additional views presenting functional schemes of specific equipment or specific areas of the ships (e.g. Hi-Fog plant or power management system monitoring and propulsion system monitoring).



All the ship zones and safety objects (e.g. valves, doors, sensors, and air conditioning) can be linked to a list or to a sequence of actions suggested in case of emergency. Each action can be executed either by the operator or automatically.





Add-on and extended functions are available, making the Martec SMCS the right solution for all safety needs:

- Through remote satellite connection it is possible to activate remote connection and perform real time operation on the SMCS system (maintenance, debugging as well as safety management).
- Decision Support System (DSS) is available from Martec and can be integrated with SMCS in order to support crew during emergency situations.

Martec activities are focused on total safety management from a global integration point view, well beyond the classical concept of software product displaying alarms and emergency control systems. Special efforts have been placed in order to provide the safety team the most advanced tools enabling to instantaneously show the total emergency situation and to quickly kill it. That effort generated the Martec safety center concept that takes total safety management to the next level.

Martec Safety Center: innovation in Emergency Management

In May 2011 Carnival Corporate Shipbuilding (CCS), together with Martec S.p.a. defined the concepts for the development of the next SMCS generation. Particular attention was placed to lessons learned from past incidents which showed that even on ships equipped with state of the art safety systems, the operators faced problems in responding promptly under heavy stress conditions during a major incident .

The solution proposed was not just an improvement of existing safety management systems, but a different approach to integrated incident management taking into account human factors. A working group was established together with Princess Cruises, having the task to develop and implement the new solution onboard a ship.

Some key points of this new approach are:

- A new ergonomic design for incident management: new Safety Centre layout.
- Integration and evolution of current safety systems to provide support in decision making in case of vessel evacuation and for the execution of the manual actions required in compliance with the new Safe Return to Port (SRtP) regulations.

The first step was to develop a new Safety Centre for the Royal Princess, having goals listed here below:

- Develop an “Electronic Incident Board” enabling the safety operators, the Staff Captain in the Safety Centre and the On Scene Officer to “draw & write” the events and actions related to an incident on plans showing the ship decks and to share this information between them.
- Review the ergonomics of current safety centre in order to improve “team interactions, communications and incident information display”.
- Extended Decision Support System (DSS) features to support operators in addressing Manual Actions required for SRtP reconfiguration.
- Develop an infrastructure to allow external watchers to view information in the SMCS, both on board, using mobile devices to improve incident control, and remotely to allow the Company Emergency Response Centre to support effectively the ship.

Martec, in close cooperation with Princess Cruises and Carnival Corporate Shipbuilding has designed a new Safety Centre and improved its Safety Management & Control Systems introducing the following features:

1. The basic infrastructure is based on well proved Martec products SMCS and DSS.
2. SMCS has been improved to enable the operators to directly draw on SMCS workstations the incident information. These graphical objects are automatically shared among all the workstations.
3. The layout of SMCS workstations in the safety centre has been totally reviewed:
   a. A large touch screen display, mounted horizontally and called the Tactical Table, is used by the Staff Captain to overview the ship condition, interrogate and control the different systems and record actions.
   b. The other operators supporting him are ergonomically seated to allow clear and easy exchanges of information, as well as easy access to information.
   c. Incident Status information is projected by a video server on a video wall thanks to a software application able to pick up selectively individual windows from each workstation and transfer them on the video wall: all systems in use can be displayed.
4. A virtual machine server has been introduced to link the SMCS network with external systems, allowing external devices to watch the information, still guaranteeing the highest security of the system. These devices can be mobile devices (used by the On Scene Officer for incident management) and remote stations (used from the Company Emergency Response Centre to support the ship).

The new safety centre has been developed and tested in the Martec research centre.

Emergency Shut Down

Product description:
Emergency Shut Down (ESD) system triggers safety actions as response to emergency events, like:

- ✓ Fire doors closure
- ✓ Ventilation stop
- ✓ Smoke extraction
- ✓ Machinery shutdown
- ✓ Side doors closure
- ✓ Low Location Lighting switching on
- ✓ CO2 shutdown sequence

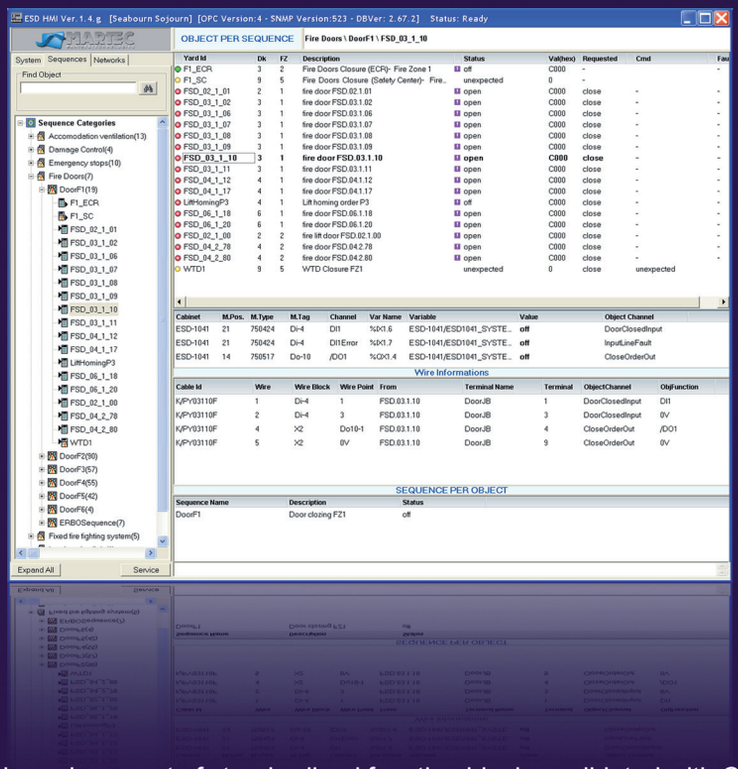
Today Yards are demanding for system integration and cost reduction. Martec is proposing a Distributed Input/Output System, fully integrated within SMCS, able to control all of the safety objects. The native integration with Martec Safety Management & Control System simplifies interfaces and reduces commissioning time.

The system is based on a number of local IO cabinets, each equipped with its own programmable local controller with redundant interface to the control network, thus ensuring the highest availability. Line monitoring on input and output is included when necessary. Cabinets are of very compact size enabling high modularity and distribution.

There is no limitation in the number of network nodes (up to 40 PLC and more).

The network has been specifically designed to withstand fire and damage conditions. Based on Ethernet Industrial and fiber optic cables it is perfectly tailored to Emergency Shutdown System.
Line monitoring on inputs and outputs allows early diagnostics and fault tracing on any interfaced systems.
A specific Human Machine Interface (ESD HMI) makes diagnosis and maintenance easier. The ESD HMI is a software module displaying the status of all the objects managed by ESD, independently from SMCS servers.

Fields of applications:
The Martec ESD concept controls all the safety elements of the ship. Due to its modularity, customization and integration with SMCS, Martec ESD can easily meet the requirements for vessels of any size from large cruise vessels, ropax vessels, offshore vessels and mega yacht.



Certifications:
The system software is based on a set of standardized function blocks, validated with Classification Societies and uses OPC protocol to export data to SMCS.
The system (hardware and software) is approved by GL, LR, ABS, BV, DNV, KR, RINA.

Main Final Customers:
Carnival Cruise Line, Carnival UK, Holland American Line, Sileversea, Cunard, Seabourn, Compagnie du Ponent, Costa Crociere

Main Yards:
Fincantieri, Meyer Werft, Mitsubishi H.I., STX France, Lloyd Werft, Mariotti, Hapag-Lloyd.

System benefits:

- ✓ Integrated and distributed system configuration.
- ✓ Highly dependable system thanks to redundancy at all levels.
- ✓ Based on accumulated experience in emergency systems design and manufacturing.
- ✓ Reduced installation and commissioning costs.
- ✓ Modular architecture prepared for future expansion.
- ✓ Low life cycle costs of service and maintenance thanks to high quality and reliable components.
- ✓ Type approved by the major Class Societies.

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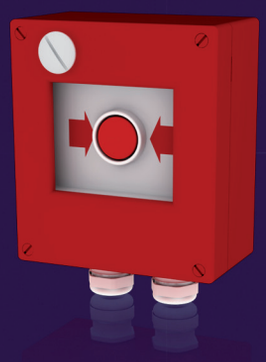
Fire Detection System

Product description:

Martec Fire Detection System (FDS) is an analogue addressable system consisting of Control Panels each connected up to 20 lines of fire sensors (up to 180 sensors on each line) by duplex cable. All of the sensors communicate with the Control Panel and receive power supply by the duplex cable. All the Control Panels are connected via a redundant Ethernet network to ensure that all of them can receive and transmit all the relevant data.

The system is very robust against all kind of failures or problems:

- The sensor network is designed to be insensitive to line cut.
- FDS is available in Safe Return to Port (SRtP) configuration, where the sensor network is not a loop but it is a line (branch) connected to two Control Panels. In this configuration the system is insensitive to single Control Panel failure.
- Control Panels redundant network makes the system insensitive to single point of failure in the Control Panel network.
- State of the art algorithms embedded inside Fire sensors dramatically reduce false detection events.



The following types of detectors are available:

- ✓ Heat (57°, 80°, 90°C).
- ✓ Combined (Smoke & Heat).
- ✓ Smoke & Heat Ex Proof.
- ✓ Flame. Each detector is equipped with 3 sensors: one for detecting combustion flames with CO2 production, the other 2 for analyzing the adjacent spectrum bands and avoid false alarms (e.g. sunshine or light mirroring from smooth surfaces).
- ✓ Manual Call Point (Accommodation).
- ✓ Manual Call Point (Machinery).

Each sensor can be mounted on various base plates:

- ✓ With/without buzzer: Buzzers do not require external 24 VDC power supply, it is provided by the detectors they are connected to.
- ✓ With/without short-circuit isolator.
- ✓ Watertight: Normally available for flame detectors fitted in balconies.
- ✓ For accommodation with ceiling.
- ✓ For Outside or Machinery Spaces: IP65 with cable penetration.

Fire Detection System can be easily integrated with Martec SMCS system.

Certifications:
RINA; Lloyd's Register; MED; GL.

Main Final Customers:
Seabourn, Silversea, CCL, Princess Cruises, AIDA

Main Yards:
Fincantieri, Meyer Werft, Mitsubishi H.I., STX France, Lloyd Werft, Mariotti

System benefits:

- ✓ Addressable system.
- ✓ Complete range of detectors.
- ✓ Possible extension to external equipment (Fire Doors, Hi-Fog).
- ✓ Colour Graphic User Interface on Central Units.
- ✓ Full integration with SMCS.
- ✓ Data communication to external systems (e.g. integrated automation system).
- ✓ In house development of hardware and software.
- ✓ Simplified installation & commissioning.
- ✓ Built in fault tracing.
- ✓ High quality components reducing the operational life cycle costs of service and maintenance.

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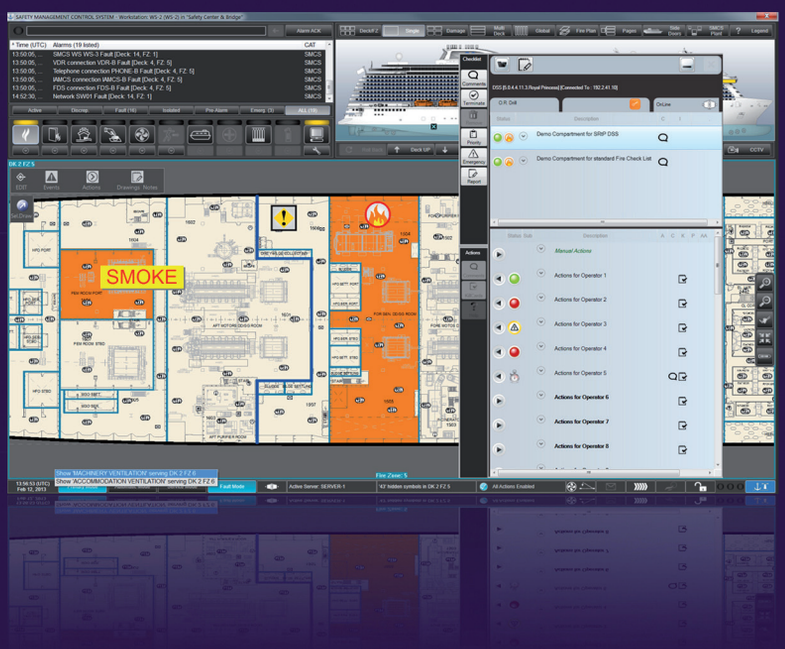
Decision Support System

Product description:

Decision Support System (DSS) is a software tool which helps the operators in managing emergency conditions on board.
DSS is integrated in the SMCS environment, exchanging data and commands with it and displaying graphic interface on SMCS workstations.

Main functions provided by DSS are:

- ✓ Support to the operator for emergency procedure execution (Check List).
- ✓ Automatic Check List selection according to:
  - ✓ Emergency type (fire, flooding, others).
  - ✓ Ship's area (cabins, galleys, etc.).
  - ✓ Optionally, ship's operation mode (in harbor, at sea, etc.).
- ✓ Automatic link to SMCS actions.
- ✓ Controlled flow chart execution.
- ✓ Reporting.

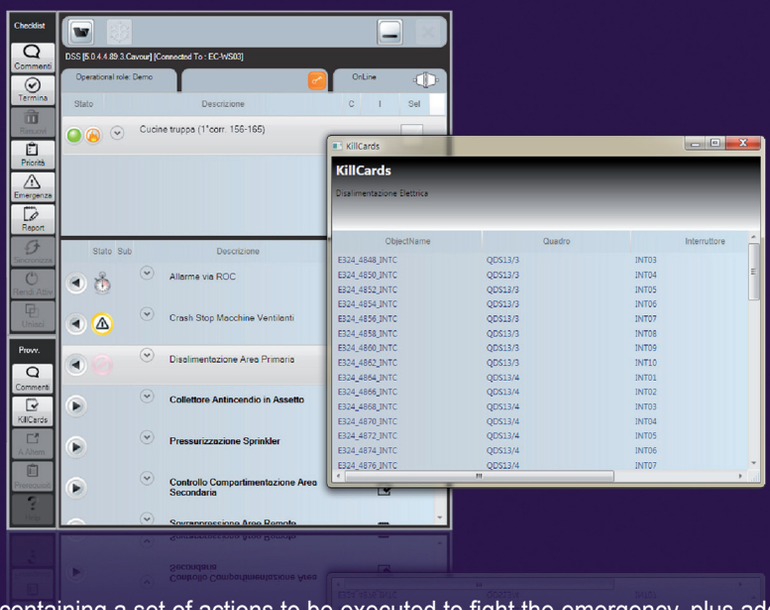


The DSS is able to help the operator during the fighting of an emergency situation onboard the vessel, presenting to him the most appropriate operational procedure for the specific emergency condition and supporting him in the procedure execution.

The operation procedure, named Check List, is selected taking into account the following information:

- ✓ The kind of emergency. Fire and flooding are considered as typical emergency conditions, but the system can be configured for any type of condition where an operational procedure is defined (as an example, ship evacuation procedure).
- ✓ The location of the emergency on board. In this way, the procedure can be tuned to the type of area (i.e. passenger cabin requires a different approach than the galley) and even to the specific location on the ship (consider a cabin area located near to some dangerous store, for which special actions shall be envisaged).
- ✓ The operational mode of the ship, like being in harbor or in navigation. This is an optional parameter, which can be considered in the DSS configuration or not.

The interaction of the operator with the DSS takes place via a dedicated window, displayed on the SMCS workstation, showing the suggested check list.



A Check List is a flow chart containing a set of actions to be executed to fight the emergency, plus additional questions to guide the execution in accordance to the evolution of the emergency. Check Lists are prepared based on the Company Emergency Procedures defined by the Ship Owner.

Actions can be classified as:

- ✓ SMCS Actions: when the operator selects it, the DSS execute them by triggering a specific SMCS action. Typical examples are “Close Fire Screen Doors of the area” or “Stop ventilation in the area”. DSS sends the command to SMCS and checks for proper command execution.
- ✓ Manual Actions, not implemented in the SMCS (like “Call the Fire Patrol”). In this case, DSS provides instructions to execute them, it records action starting, action ending and action results (completed, failed).

Whenever an action implies knowledge of the specific area where the emergency is active, the DSS supports the operator by providing timely information, named kill-cards. At the end of the emergency, a complete report of the Check List execution is provided, showing all the actions and decision taken, with time stamps and comments.

Fields of applications:

DSS is a decision support system able to interact with Martec SMCS. This makes Martec DSS the best choice in all of the scenarios where safety has to be guaranteed through proper procedures that are zone dependent and kind of emergency dependent, where manual actions, remote driven manual action as well as automatic actions are required.
Cruise vessels, naval vessels and offshore vessels/platforms are typical scenarios where DSS can be successfully applied.

Main final customers:

Princess, CCL, Cunard, P&O, Seabourn

Main yards:

Fincantieri, Meyer Werft, Mitsubishi H.H., STX France, Loyd Werft, Mariotti

System benefits:

- ✓ Tailor made in accordance to the Customer requirements.
- ✓ Based on a extensive application experience of safety management systems.
- ✓ User friendly operation.
- ✓ Prepared for future expansion.
- ✓ Improves the overall operational safety concept of the vessel.

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